

# Evaluation of occupational injuries among welders in Northwest Iran



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## Abstract

**Introduction:** Welding technology is one of the most commonly used industries by mankind. Welders have an essential role in production. Injuries affecting welders directly contributes to posing healthcare costs on the individual and society, decreased productivity, wasted time and more.

**Objectives:** This study was designed to investigate occupational hazards related to welders.

**Patients and Methods:** In this study, 50 employed welders in city workshops were selected and their data was collected by interview and questionnaire. Analytical and descriptive statistics were used to analyze the data.

**Results:** The results showed 92% of welders suffer eye problems while 86% of them actually used their protective glasses. Forty-four percent suffered from hearing loss, and 88% had musculoskeletal problems particularly in the knees, neck and back. Around 36% did not use respiratory masks for preventing inhalation of the fumes.

**Conclusion:** The extents of occupational hazards in this profession are high. The last level of safety is the use of safety devices. Nevertheless, most of these devices are not used by the welders. Excessive working hours, long employment history, unsafe working environment for the presence of high background radiation and gases cause several problems in welders. The most commons are eye injuries and musculoskeletal pains.

## Introduction

Accidents and occupational diseases are the main obstacles in producing and suitable productivity. The World Health Organization (WHO) estimates that each year 68 to 157 million people are suffering from occupational diseases. Thirty percent to 40% of the above mentioned people are suffering from chronic diseases, and 10% are suffering from permanent disability (1). According to the Social Security Organization of Iran, the cost of damages caused by occupational accidents during 10 years has increased 9.4 times and it has reached from 38 billion dollar in 1991 to 5 billion dollar in 2001 (2). According to the definition of Americans Welding Society (AWS), welding is the process of joining metal by heating and warming to the suitable temperature with or without the use of filler metal. This profession involves cutting metal objects (cutting), brazing and, in some cases, soldering (1). Welding is considered as one of the major components of many

## Core tip

The extents of occupational hazards in this profession are high. In a study on 50 employed welders, we found the most common occupational hazards are eye injuries and musculoskeletal pains.

industries. Joining various parts of different metals and alloys, increasing the strength and speed of operations and reducing costs are the purposes of welding. In 1988, the US National Institute for Occupational Health and Safety (NIOSH) estimated that at least 2 million workers worked as welders (3,4). Occupational exposures of welding fall into two general categories; chemical and physical damaging factors (5). Harmful chemical factors in welding depend on the techniques of welding, the used metal and metal elements of welding electrodes, working in open or closed environment and proper ventilation. Health risks and the effects of gases, vapors and welding fumes depend on the exposure

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time, type of welding processes, working conditions and protection practices (1,6-9). Different types of respiratory diseases in welders are:

### **Rhinitis**

Rhinitis may be resulted in welding of steel including manganese, stainless steel and contacts with rosin during soldering.

### **Asthma**

Asthma can be seen in welding of stainless steel, due to the presence of hexavalent chromium, contacts with rosin or the creation of ammonium chloride and zinc chloride in soldering and released materials from the decomposition of colors (isocyanate) during welding (1,10).

### **Chronic bronchitis and emphysema**

Emphysema and chronic bronchitis can be seen in welding usual steel, stainless steel and aluminum. The rate of chronic bronchitis and gradual reduction of pulmonary indexes in welders are more than under controlled individuals (4,9,1-15).

### **Pulmonary edema**

Pulmonary edema can be seen in flame cutting welding and gas welding. High density of N<sub>2</sub>O and ozone inhalation in arc gas & shielded welding causes pulmonary edema. This is true about tungsten inert gas (TIG) welding of aluminum which produces ozone at high density. Pulmonary edema can be seen during welding due to the presence of high density cadmium oxide and also welding in the environment including chlorinated hydrocarbons (due to the presence of phosgene) (1).

### **Pneumonia**

There is evidence that immune suppression occurs in welders and it increases the frequency, duration and severity of upper and lower respiratory tract infection in them (8).

### **Pneumoconiosis**

Welding are suffering from siderosis because of iron oxide. In addition to iron oxide, welders have contact with non-crystalline silicon dioxide and asbestos, fluoride, aluminum, chromium, cadmium, manganese, nickel, ozone, phosgene and nitrogen dioxide that the combination of the materials and inhalation of high density welding fumes in bad working conditions, over many years, can cause pulmonary fibrosis (1,16).

### **Inhalation fever resulted from metals' fumes**

Almost 48% of welders over 58 years are suffering from this disease and the most common cause of this problem is welding on galvanized steel (due to the presence of zinc) (6,17).

### **Lung cancer**

Welding falls in in B2 group of the International Agency

for Cancer Research (IARC) that is probably due to the presence of chromium and nickel in stainless steel. Also the confounding effects of smoking and asbestos makes it difficult to determine the definitive relationship (8,18).

### **Decreased lung function**

The effects of welding fume inhalation on lung function of welders are different and this difference can be related to factors such as location of study (in the laboratory or under control workplaces or actual workplaces) difference in the intensity of exposure to welding fumes, differences in the welding process, the length of exposure, ventilation of the workplace as well as other confounding factors such as smoking (4,8,13).

### **Cardiovascular disorders**

Increasing the density of interleukin-6 in plasma increases the risk of coronary artery diseases and heart attack (19-21).

### **Physical harmful factors**

These factors include:

- I. Musculoskeletal injuries among welders who complain of musculoskeletal disorders such as back injuries in the body, shoulder pain, reduced muscle strength, carpal tunnel syndrome, fingers becoming white and knee joint diseases (22).
- II. The electromagnetic field including visible light, ultraviolet and infrared rays. Intensity of light emitted from welding arc causes damage to the retina, while infrared radiation may damage the cornea, consequently, leading to cataracts development. Invisible ultraviolet light from the arc, even in a very short time less than one minute, causes blight eye (23).

The other disorders caused by occupational exposure are abnormal idiopathic spermatozoa. Human in his job and life environment contacts with factors that could jeopardize the reproductive system functioning (24,25). Before the start of welding, it is required to identify the specific risks of this operation. These risks are different and depend on the type of welding, used materials (main metals, surface coatings, electrodes) and working conditions (open or closed environments) (26).

### **Objectives**

The aim of this study is to assess the level of awareness of occupational injuries and the proper observance of safety issues facing workers in small workshops (connection of structural metal materials, cutting, windows and doors construction, etc.) in Ardabil city.

### **Patients and Methods**

In this descriptive study, the studied populations were welders employed in workshops Ardabil city. Fifty samples of the welders were selected by cluster sampling from different regions of Ardabil and a questionnaire, containing basic and specific questions, designed by the members of the research group, was completed through a short interview with the

welders. The basic questions or demographic factors part of the questionnaire included work experience, education and insurance status. In the “specific questions” part of the questionnaire, nine general parameters, including damage to the eyes, ears, muscle-skeleton, lungs, and damages caused by working with electricity, burns, falls from height, cutting and finally noticing to the first aid and safety tips were considered. In each part, any question was measured regarding the use of related safety equipment, knowledge level, and attitude towards welding technology, visiting the doctor and the impact on productivity.

### Ethical issues

The research followed the tenets of the Declaration of Helsinki; informed consent was obtained; and the research was approved by the ethical committee of Ardabil University of Medical Sciences.

### Statistical analysis

Data from the completed questionnaires was entered to SPSS version 16 and charts were drawn to display and analysis of the data. Descriptive and analytic statistics were used to analyze the data.

### Results

The study included 50 welders with an average age of 34.6 years (range; 19-62 years). In terms of education, only 54% of the welders passed primary and secondary education. The average work experience was 13.47 years and average daily working hours was 9.92 hours. The percentage of the

use of safety equipment, effectiveness and welders’ attitude towards the use of these devices is shown in Table 1.

The rate of the effectiveness of safety devices was defined as the percent of the use of the welding device at the time of incident. Most welders used goggles and headphones, while about 14% of them believed that the use of goggles and headphones reduced efficiency (Table 1). Eye injuries had the highest number of injuries followed by musculoskeletal pain (88%) and cuts (86%), respectively (Figure 1).

Among the participants in our study, the history of visiting doctor since the beginning of welding was 60% for eye injuries, 58% for muscle –skeletal aches and 20% for respiratory problems. Twenty-nine of the 50 studied cases were smokers. Thirty-two percent of the welders had no health insurance. Information collected from welders’ awareness about the risks and the necessity to use the safety devices and protective eye goggles was about 90%, about headphone was 88%, about electrical risks was 68% and about proper ways of load carrying was 40%. Only the awareness about proper ways of load carrying and transportation of heavy equipment is low. Information about workplace safety, work equipment safety and safety equipment is shown in Figure 2. Safety warning signs were only considered 2% in welding workshops. Around 42% of the participants did not have first aid kits or any type of simple medical equipment in their workplace. Fire extinguishers were found only in 22% of workshops. Moreover, 80% of the participants did not use worktable and 64% of them did not use automatic

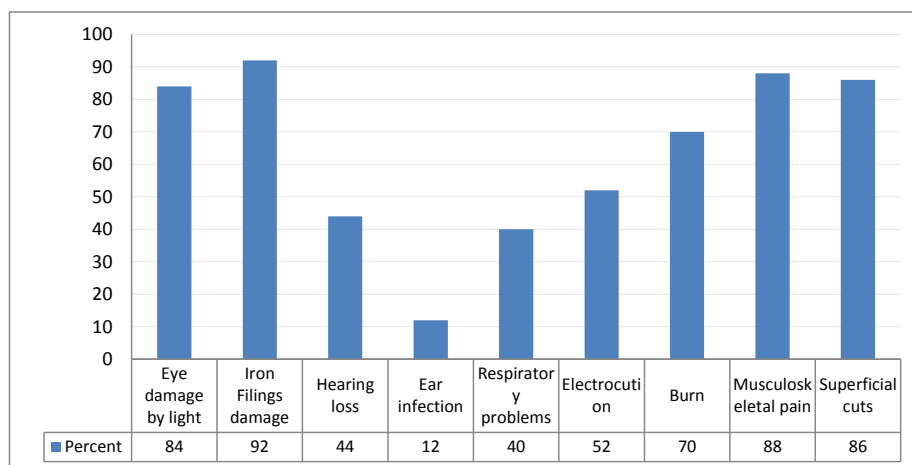
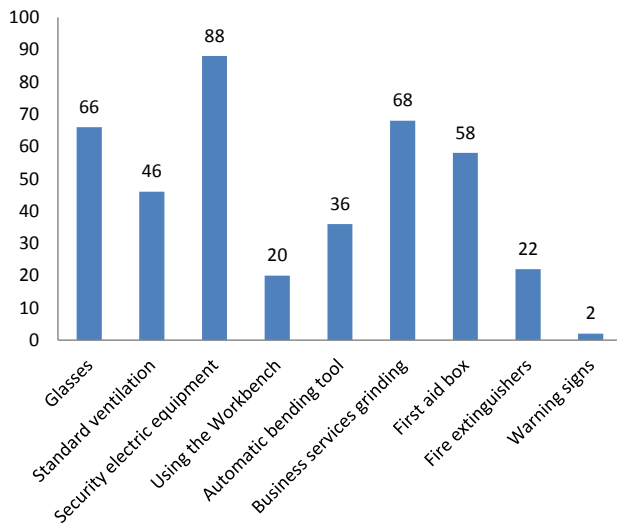


Figure 1. Frequency of damages among welders.

Table 1. Uses safety devices between welders

Safety Devices	Uses rate (%)	The percentage of those who use it know of diminishing returns	Efficacy
Glasses- Eye protection	86	14	17
Ear protection	64	12	30
Respiratory masks	36	-	40
Gloves and gowns	60	-	48
Insulated shoes	56	-	-
Belt fall protection	14	-	-



**Figure 2.** Idea of welders about health and safety equipment.

bending equipment. Half of the welders did not consider their workshops' ventilation. Twelve percent of the welders did not check their electric equipment.

Around 34% of the participants did not assess the accuracy and quality of the glass of the goggles (Figure 2), 44% had hearing loss and 46% of them did not use belt and fall protection devices. Accordingly 32% of the welders did not have a good medical services while 48% of the welders did not have health and skill cards.

## Discussion

More work experience certainly represents the existence of long-term injuries. In this study, most of the employed in welding profession had 13 years working experience (average) and half of them had over 13 years working experience that can be a reason for the high incidence of damages caused by work. Work experience is crucial in chronic injuries. Encouraging the workers to use protective goggles and increase their awareness on the proper use of safety equipment, is an effective step to prevent work ocular injuries. In this study, eye injuries such as harmful effects of looking at radiations from welding or entering iron fold to eye account for the largest percentage of eye injuries (23). Also low performance of protective eye glasses and lack of quality control of these devices increased the injuries among the welders (27). However, a significant percentage (40%) of these people did not visit the doctor for eye problems and they accepted these problems as a part of their jobs. Regarding financial and economic issues, welders are middle-class, and therefore treatment costs have a great impact on the quality of their lives and health. Because of this fact, insurance status variable was evaluated in our study. The results showed that about 32% of welders did not have any health insurance and, consequently, they were imposed more medical expenses. In this study, muscle-skeletal damages such as joint pain, knee pain, backache, etc, with a prevalence of 88%, was the second case among the damages caused by not using ergonomic equipment in long working

hours (an average of about 10 hours daily throughout the week) and lack of knowledge of the workers about methods of carrying load (60% were not aware about the procedures). It should be noted that, however, awareness is not only a necessary condition for the development of health behavior. Work-related musculoskeletal disorders is considered as an occupational disease. These disorders are usually intensified because of undesirable body positions while working or use of inappropriate and substandard worktable. The WHO has reported that 37% of backaches are from occupational risk factors that have the first place among diseases and work-related risks.

Musculoskeletal disorders in the workplace occur due to poor conditions. One of the causes of this problem is the tools that people use at work, which should be standardized. Working in a good body condition, using the suitable tools in accordance with the principles of ergonomics, the availability of the tools, reducing repetitive tasks and taking care of body fatigue while working are the most important management strategies of musculoskeletal injuries. According to a national study, conducted in 2004 by Ministry of Health, it was identified that backache, osteoarthritis and other musculoskeletal disorders resulted from working are the most important diseases after cardiovascular diseases in Iran. A variety of cuts including surface cuts and finger cuts were observed among workers and, with 86% of prevalence, it is one of the most common damages. Not using proper gloves, lack of proper maintenance of cutting tools and use of unprotected grinding were some of the causative factors. In the present study, 70% of the subjects had an experience of burn during welding that was mostly in their hands and faces. Welders who work in cutting with gas are more at risk of serious burns. Damages related to the released gases are chronic and very harmful. By working in workshops containing dust, smoke, gases and too much vapors, workers are at risk of occupational respiratory diseases. Workers who smoke also have a higher risk of developing lung diseases. Heat, closed work place and poor ventilation increase the risk of disease. Welding fumes of metals are heated and cooled quickly. This process, which results in the movement of tiny solid particles in the air, can be underlying reason for pulmonary diseases. Ventilation systems can remove pollutants and toxins in the air and reduce their exposure and prevent their accumulation. In our study, 40% of the workers had respiratory problems and 52% were smoker that plays a significant role in exacerbating respiratory damages. It should be noted that the effects of factors such as inhaling of fumes do not appear in short term. Hence, we are dealing with a group of workers who are heavily exposed to various diseases and illnesses. Work experience is one of the most important factors that can affect the incidence of occupational injuries. The more level of awareness of the risks will result the more health behaviors. Education and awareness directly affects the amount of attention to safety points. Lack of supervision and training in the health sector has sharply increased the vulnerability of this group of people who play a major role

in manufacturing industry. For welders' workplace safety, increasing welders' knowledge of the dangers and the need to comply with safety standards, business skills courses, the use of ergonomic equipment, solving health insurance problems and quality control of safety equipment are recommended.

### Limitations of the study

This study was conducted in a single center with limited proportion of patients. We suggest larger studies on this subject. The major limitation of this study is that it is a retrospective study.

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### Authors' contribution

MB and FA; considered initial idea to design the study, prepared and wrote the final manuscript. SH; contributed to gather data. FA; contributed to data analysis and explanation of data.

### Conflicts of interest

There were no points of conflicts.

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